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Subtle differences in brain network connectivity in children who stutter

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Abstract

Stuttering is an idiopathic speech disorder with symptom onset occurring during the early phases of speech acquisition. To date, the vast majority of studies examining the neural bases of stuttering have focused on stuttering adults, whose functional neuroanatomy may reflect adaptive and compensatory processes acquired as a result of decades of stuttering. The etiology of stuttering remains unclear; compared to other neurodevelopmental disorders, few studies to date have examined the neural bases of childhood stuttering. In this presentation I will present results from functional (resting state fMRI) and structural connectivity analyses (DTI probabilistic tractography) of multimodal neuroimaging data examining neural networks in children who stutter. A total of 56 children, 27 stuttering (mean age: 77.1 mo.) and 28 age matched controls (mean age: 76.9 mo.) participated in this study. All children were right handed, monolingual English-speakers, with language skills within normal limits. Diffusion tensor imaging (DTI), resting state fMRI, and high-resolution structural scans (MPRAGE) were acquired from all children. We hypothesized, based on preliminary data and predictions derived from published speech models, that stuttering children would exhibit primarily left-sided functional neuroanotomical differences relative to controls, in areas supporting auditory-motor integration for speech production. We examined how synchronized brain activity occurring among brain areas associated with speech production, and white matter tracts that interconnect them, differ in young children who stutter (aged 3-9 years) compared to age-matched peers.

Results showed that children who stutter have attenuated connectivity in neural networks that support timing of self-paced movement control. The results suggest that auditory-motor and basal ganglia-thalamocortical networks develop differently in stuttering children, which may in turn affect speech planning and execution processes needed to achieve fluent speech motor control. These results provide important initial evidence of neurological differences in the early phases of symptom onset in children who stutter. The same children will be followed longitudinally so that brain developmental trajectories can be examined for subtle growth patterns that correlate with persistent stuttering versus spontaneous recovery. These results are expected to contribute to developing novel clinical applications for effective clinical management of stuttering cases in the future.

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